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Issued May 21, 1912.

U. S. DEPARTMENT OF AGRICULTURE
BIOLOGICAL SURVEY—BULLETIN No. 42
HENRY W. HENSHAW, *Chief*

REPORT

OF AN

EXPEDITION TO LAYSAN ISLAND IN 1911

UNDER THE JOINT AUSPICES OF THE UNITED STATES DEPARTMENT OF AGRICULTURE AND THE UNIVERSITY OF IOWA

BY

HOMER R. DILL

Assistant Professor of Zoology in the State University of Iowa

AND

WM. ALANSON BRYAN

Professor of Zoology in the College of Hawaii

WASHINGTON
GOVERNMENT PRINTING OFFICE
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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., January 11, 1912.

SIR: I have the honor to transmit herewith for publication Bulletin 42 of the Biological Survey, "A Report of an Expedition to Laysan Island in 1911," in two parts, the first by Prof. Homer R. Dill, of the State University of Iowa, and the second by Prof. Wm. Alanson Bryan, of the College of Hawaii, Honolulu. Prof. Bryan had previously visited the island in 1903 and was thus able to note the changes which had occurred during the intervening eight years. The Hawaiian Islands Reservation was established by Executive order in 1909 to serve as a refuge and breeding place for the millions of sea birds and waders that from time immemorial have resorted there yearly to raise their young or to rest while migrating. In 1909 a party of feather hunters landed on Laysan, one of the twelve islands comprising the reservation, and killed more than 200,000 birds, notably albatrosses, for millinery purposes. Through the prompt cooperation of the Secretary of the Treasury, the revenue cutter *Thetis*, under the command of Capt. W. V. E. Jacobs, was dispatched to the island and returned to Honolulu in January, 1910, with 23 poachers and their booty, consisting of the plumage of more than a quarter of a million birds. In the spring of 1911 a cooperative arrangement was effected with the University of Iowa, represented by Prof. C. C. Nutting, head of the zoological department, whereby an expedition was sent to Laysan, the largest and most important island of the group, to ascertain the present condition of the bird rookeries and to collect a series of birds for a museum exhibit. Through the cooperation of the Secretary of the Treasury and the Commandant of the Revenue Cutter Service the revenue cutter *Thetis* was placed at the disposal of the party. The members were transported from Honolulu to the island in April, and two months later returned to Honolulu. Through the courtesy of the Secretary of War transportation was also furnished on Army transports for members of the party and their equipage between San Francisco

and Honolulu. Without this assistance it would have been extremely difficult to arrange for the transportation of the expedition.

The present report embodying the results of the observations made by the party contains many interesting facts and gives an approximate census of the birds nesting on Laysan Island at the time of the visit of the party, together with recommendations for the future protection of the reservation.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. JAMES WILSON,
Secretary of Agriculture.

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REPORT OF AN EXPEDITION TO LAYSAN ISLAND IN 1911 UNDER THE JOINT AUSPICES OF THE UNITED STATES DEPARTMENT OF AGRICULTURE AND THE UNIVERSITY OF IOWA.

PART I.

REPORT ON CONDITIONS ON THE HAWAIIAN BIRD RESERVATION WITH LIST OF THE BIRDS FOUND ON LAYSAN.

By Homer R. Dill,
Professor of Zoology in the State University of Iowa.

INTRODUCTION.

PURPOSE AND MEMBERS OF THE EXPEDITION.

On February 3, 1909, President Roosevelt issued an Executive order to the effect that the islets and reefs, namely: "Cure Island, Pearl and Hermes Reef, Lysianski or Pell Island, Laysan Island, Mary Reef, Dowsetts Reef, Gardiner Island, Two Brothers Reef, French Frigate Shoal, Necker Island, Frost Shoal, and Bird Island, situated in the Pacific Ocean at and near the extreme western extension of the Hawaiian Archipelago, * * * are hereby reserved and set apart * * * as a preserve and breeding ground for native birds. * * * This reservation to be known as the Hawaiian Islands Reservation."

The purpose of the reservation was to insure for all time a refuge and breeding place for the numerous species of birds, chiefly sea fowl, that for ages past had made the islands their home during the whole or a part of each year. In the spring of 1909, however, a party of foreign plumage hunters landed on Laysan, the principal bird rookery of the reservation, and for several months made the slaughter of sea birds a business. Had they not been interrupted, they would probably have exterminated the entire colony of birds on this island and perhaps on others of the group. As it was, many thousands of sea birds were destroyed, especially albatrosses. There is, however, no reason to doubt that, if left to themselves as much as possible and if further depredations can be prevented, the birds will in time repair this loss and continue to live as they have for thousands of years before civilized man intruded on their beautiful avian world.

Through the instrumentality of Prof. C. C. Nutting, head of the department of zoology, State University of Iowa, arrangements were made in 1911 with the Secretary of Agriculture to send a cooperative expedition to Laysan. The principal objects of the expedition were to obtain for the Bureau of Biological Survey of the department data for a comprehensive report as to the present condition of the rookeries and as to the effects of the nefarious work of poachers on the avifauna and to make a collection of the birds, their nests, eggs, and the necessary accessories for making a large panoramic group for the State University of Iowa.

The personnel of the party consisted of the writer and three assistants, Mr. H. C. Young, Mr. C. J. Albrecht, and Mr. C. A. Corwin. Mr. W. A. Bryan joined the party in Honolulu as the representative of the Department of Agriculture, spent a week on Laysan, and returned to Honolulu on the *Thetis*.

The writer is indebted to Mr. E. M. Ehrhorn, Mr. D. B. Kuhns, Mr. Max Schlemmer, Mr. W. A. Bryan, the members of the University Club, and others for their kind assistance and hospitality while in Honolulu. I wish also to acknowledge the invaluable assistance of the men who accompanied me: Mr. H. C. Young, who assisted in assembling data for this report, Mr. C. J. Albrecht, who made the photographs, and Mr. C. A. Corwin, who made paintings for our group. I am also indebted to Mr. Dayton Stoner, of our museum staff, for his careful drawing of the map on which I have indicated the bird rookeries.

HAWAIIAN ISLANDS RESERVATION.

The Hawaiian Islands Reservation is composed of the islands and reefs included in the leeward chain extending in a northwesterly direction from the main Hawaiian Group. These islands are situated from 100 to 300 miles apart and are composed principally of lava. Laysan, the largest island of the reservation, is low and flat, the highest point being only 50 feet above sea level. On the surface of this island is a layer of coral sand and phosphate rock. Laysan has an area of about 2 square miles; the others vary in size from 1 square mile to small rocky reefs. Bird Island is high and precipitous, having a peak of 903 feet, and one side of the island is perpendicular.

These islands have a vegetation of low bushes and sand grasses. The climate is warm but not enervating, tempered as it is by the northeast trade winds. Severe thunder storms are almost unknown.

At the present time the islands are entirely uninhabited by man, and indeed landing can be effected only in favorable weather; but they offer excellent nesting sites and abundant food for the millions of sea birds which resort to this remote oceanic reservation.

WATER AND NATURAL FOOD SUPPLY.

Frequent but short showers supplied us with plenty of drinking water. I have recorded them as follows: April 24, April 27, May 2, May 3, May 14, and June 2. We carried a small still for use in case our water supply failed us, but did not have occasion to use it, although our supply was reduced at times. There is an old well on the island, but it is no longer of use. The pump is rusted out and the well has partly filled with sand.

Plenty of good fish can be found in the still water between the surrounding barrier reef and the shore, and they can easily be shot with a good rifle. Crawfish also are obtainable and are easily caught in the evening by using a small lantern and a spear.

Large turtles are found along the beaches, where they crawl out to sun themselves. When turned on their backs they are helpless. We killed one of these turtles and found the meat very good, but the eggs we did not find palatable. This turtle was 4 feet long, 3 feet wide, and 1 foot 5 inches from carapace to plastron. We estimated her weight to be 300 pounds.

The rabbits are good for food and their flesh seems to be entirely free from parasites. When not frightened they may be easily caught in the hands.

Although there were many edible shore birds on the island, our party did not kill any of them for food. The only birds eaten were those collected for scientific purposes.

SEALS.

A little-known species of seal[1] is reported to live in the region of Laysan Island. Mr. Max Schlemmer says that during the 15 years he lived on the island seven of these animals were killed. He at one time gave Dr. Schauinsland a fine large skull of this species, which was taken to Germany. No signs of seals were noted while we were on the island, notwithstanding a sharp lookout was kept by the members of our party.

RABBITS INTRODUCED ON LAYSAN.

Mr. Max Schlemmer, the former manager of the guano company on Laysan, introduced domestic rabbits, Belgian hares, and English hares into the island at different times, and left them there to breed, intending to start a rabbit canning business. He could not give the

[1] This species has been described by Dr. Matschie as *Monachus schauinslandi* (Sitz. Ber. Ges. Naturf. Freunde, Berlin, p. 254, 1905). In 1900 a sick or helpless seal was caught by the natives in Hilo Bay, Hawaii, towed ashore, killed, and eaten. Unfortunately I was too late to secure any part of the animal for identification, but the natives assured me that solitary seals occurred on the coast about once in 10 years or so. They were very curious and asked many questions as to the habitat of the animal, its nature, food, and habits, about which they knew nothing.—H. W. HENSHAW.

exact dates but thinks the first were imported eight or nine years ago, or about 1903. The rabbits have crossed and produced some strange-looking animals, both in form and color. We dressed some of them for food and found the skins as tough and thick as that of the groundhog.

Rabbits have killed many bushes, but have not caused so great devastation as one would expect from their numbers. In the latter part of the afternoon they may be seen feeding. They are very fond of the green juncus that grows near the lagoon, and, while they are eating, their bodies are concealed among the thick growth and only their ears show. At times there are so many ears protruding that they resemble a vegetable garden.

It would be very difficult to exterminate these animals without harming the birds. They live everywhere; even in the large tern rookeries we saw many of them. They have made burrows of their own and also, when pursued, take refuge in the numerous petrel burrows. It is impossible to drive or snare them, as there are plenty of holes in which they can find shelter. Poisoning the rabbits would be disastrous to certain species of birds and indiscriminate shooting would also be harmful. It is my opinion that a well-organized party with small repeating rifles, say 22 caliber, could entirely exterminate these pests. This should be done in the season when it would interfere least with the nesting birds.

The man-o'-war birds catch them. Several times we saw them pick up full-grown rabbits, and we found young ones dead on the nest of the red-footed booby.

GUINEA PIGS.

Guinea pigs were found on the south end of the island in the thick juncus. They were rather abundant in this one place, seven being seen at one time, but they have done no harm. Mr. Schlemmer introduced these animals.

INSECT PESTS.

The collector is not without his troubles on Laysan. Never have I seen so many flies in one small area. Our laboratory was so full of them that we were obliged to suspend work to reduce their numbers. Shallow pans of formalin, about 2 per cent, did wonders in this direction. Not only did the flies annoy us as we worked but they would blow our bird skins, and even after the latter were thoroughly dry and cured, we often found fresh masses of eggs deposited on the feathers. The feet of the larger birds would be eaten by larvæ if they were not thoroughly poisoned.

In addition to the flies there were small ants which ate and destroyed the feathers of the smaller specimens. There were also several

species of beetles, the larvæ of which devoured everything that was not well poisoned.

Plenty of netting is needed to keep flies away from the skins while drying. Rough frames should be made and their legs immersed in pans of water, in order that boxes of skins may be placed in safety from the ants. The beetles are, however, harder to control, for they seem to reach the skins notwithstanding the netting. If the skins show signs of larvæ, put them in a tight box with a good cover. In the top of the box place a shallow pan of carbon bisulphide, using about one tablespoonful of the fluid for every cubic foot of space. Cover the box tightly, allowing it to remain 48 hours. The carbon bisulphide should be put in the top of the box, since the gas settles. This should be repeated in about seven days, so as to kill the larvæ that may have hatched in the meantime. Where pests are so prevalent, I recommend treating each box of skins in this manner as they are packed for shipment.

The acres of carcasses left by the poachers have furnished breeding places for flies and beetles; hence their great numbers.

BIRDS AS SEED CARRIERS.

Mr. H. W. Henshaw, Chief of the Biological Survey, requested that our party make careful observation as to the presence of seeds or balls of earth attached to any portion of the bills, feet, or plumage of the island birds, since there is reason to believe that birds play an important part in the transplantation of seeds from shore to shore.

In handling and preparing 400 specimens we found but one that was of interest in this connection. On the foot of a Laysan albatross, between the second and third toes, was a spinate seed about the size of a flattened buckshot, the spines of which were firmly embedded in the sides of the toes. The seed was sent to Washington, where it was identified as the seed of *Tribulus lystrix* R. Br. This species belongs to the family *Zygophyllaceæ* and is generally distributed in the South Sea Islands. So far as known there is no record of its occurrence on Laysan, but a thorough examination of the flora might reveal its presence there.

NARRATIVE.

The 17th day of April, 1911, our party sailed from Honolulu on the revenue cutter *Thetis*. During the first five days of our trip few birds were seen except a number of black-footed albatrosses (*Diomedea nigripes*) that followed the ship nearly all the way. When within about 50 miles of Laysan, their numbers increased, and later they were joined by one or two of the white species (*D. immutabilis*), also by a few sooty terns (*Sterna fuliginosa*) and wedge-tailed shearwaters (*Puffinus cuneatus*).

About 11 o'clock of the seventh day the island was sighted. We expected to see clouds of birds about it, but in this we were disappointed. It was too early for terns to arrive in large numbers. We reached the shore about 3 o'clock and spent the remainder of the day in landing our outfit and repairing the old building for our use. (Pl. I.) By 6 o'clock everything was beached and the *Thetis* sailed to Midway Island, coming back a week later for our mail and to say farewell until the 5th of June, when she returned for our party.

Our first impression of Laysan was that the poachers had stripped the place of bird life. An area of over 300 acres on each side of the buildings was apparently abandoned. Only the shearwaters moaning in their burrows, the little wingless rail skulking from one grass tussock to another, and the saucy finch remained. It is an excellent example of what Prof. Nutting calls the survival of the inconspicuous.

Here on every side are bones bleaching in the sun, showing where the poachers have piled the bodies of the birds as they stripped them of wings and feathers. In the old open guano shed (Pl. II) were seen the remains of hundreds and possibly thousands of wings which were placed there but never cured for shipping, as the marauders were interrupted in their work.

An old cistern back of one of the buildings tells a story of cruelty that surpasses anything else done by these heartless, sanguinary pirates, not excepting the practice of cutting the wings from living birds and leaving them to die of hemorrhage. In this dry cistern the living birds were kept by hundreds to slowly starve to death. In this way the fatty tissue lying next to the skin was used up, and the skin was left quite free from grease, so that it required little or no cleaning during preparation.

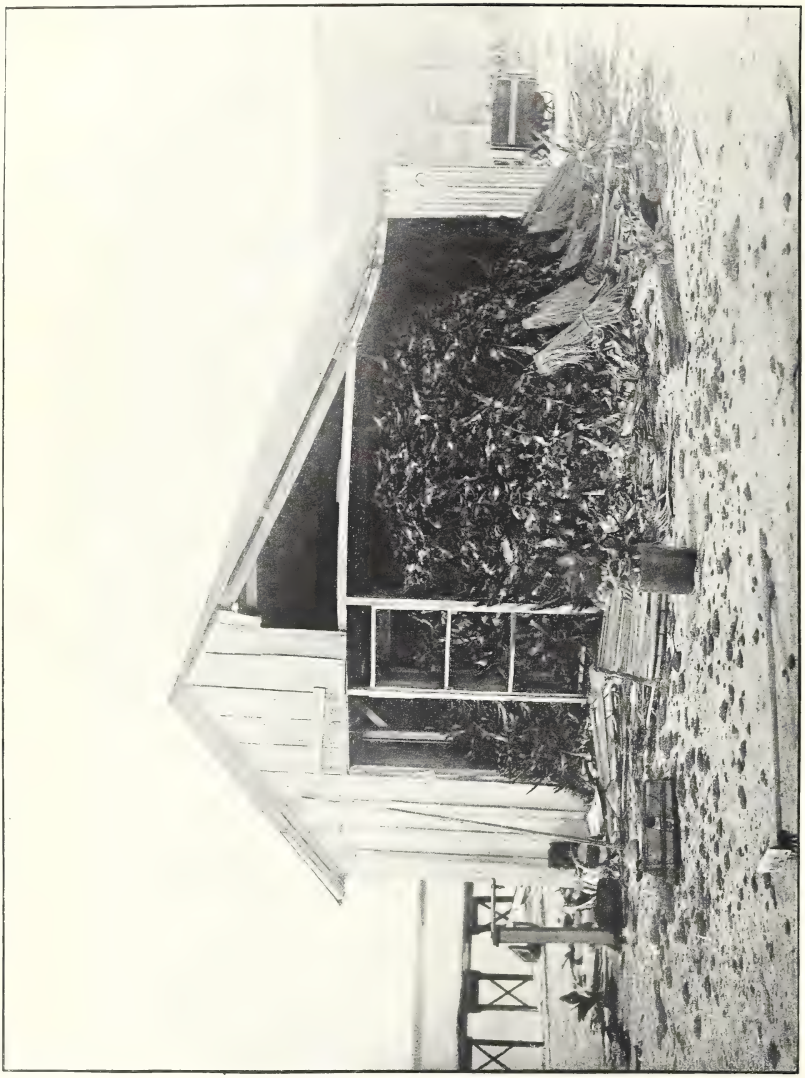
Many other revolting sights, such as the remains of young birds that had been left to starve and birds with broken legs and deformed beaks, were to be seen. Killing clubs, nets, and other implements used by these marauders were lying all about. Hundreds of boxes to be used in shipping the bird skins were packed in an old building. It was very evident they intended to carry on their slaughter as long as the birds lasted.

Not only did they kill and skin the larger species but they caught and caged the finch, honey eater, and miller bird. Cages and material for making them were found.

Half an hour's walk, however, will take one to an entirely different scene. The north, east, and south parts of the island have not been disturbed to any extent by the poachers, they having confined their work largely to the area nearer the buildings and along the car track formerly used by the guano company.

We found some species on the east side even more abundant than reported by Prof. Nutting in 1902. It is interesting to note the

BUILDINGS ON LAYSAN ISLAND.



ALBATROSS WINGS PILED IN OLD GUANO SHED, LAYSAN ISLAND.

habits of the gregarious little creatures. For countless generations they have lived in a crowded community, like the inhabitants of our larger cities, and now, although the killing of thousands of birds on the west side of the island has made nesting places available elsewhere, they still live as did their predecessors, nesting as closely as possible.

In collecting birds that had young, much care was exercised not to take both parents and thus to leave the nestlings to perish. This made the collecting of some species difficult and slow. Fortunately we were able to preserve and so utilize many birds that were found dead on the rookeries, the mortality from natural causes being large.

LIST OF BIRDS ON LAYSAN.

It is not my intention to attempt to duplicate the excellent report on the birds of Laysan Island by Dr. Walter K. Fisher[1] in 1902, to which readers are referred for many details here omitted. We found the same species that he did, with the addition of Bulwer's petrel and the sooty petrel (*Oceanodroma tristrami*). The following is a list of the island birds, with notes on their distribution, habits, nests and eggs, etc., as observed by our party:

LARIDÆ.

Sterna fuliginosa Gmelin. Sooty-backed Tern.

Upon our arrival at Laysan we did not observe many sooty-backed terns. There was a small colony of about 500 birds on the southwest part of the island and another of about the same size on the extreme east. We found great piles of bones near the former that led us to believe that the birds had been much reduced in numbers by the plumage hunters.

About the 6th of May thousands of them appeared on the east side of the island and about a week later others came to the southwest. Their numbers increased each day. As the southwest rookery grew, it extended toward the north. For some reason known only to themselves the birds confined their nesting to the area on the west side of the small car track, which is indicated on the accompanying map. We found a few nests between the rails, but none on the east side of the track. The first day of June we measured the rookeries of these birds, and two days later we went over the same ground again. We found that in two days the rookeries on the west side had increased in area 3,600 square yards.

The final estimate of the number of sooty terns was made June 4—333,900 for both rookeries. This species outnumbers any other on the island. We found as many as 7 and in some cases 9 nests to the

[1] Birds of Laysan and the Leeward Islands, Hawaiian Group, in U. S. Fish Commission Bulletin for 1903.

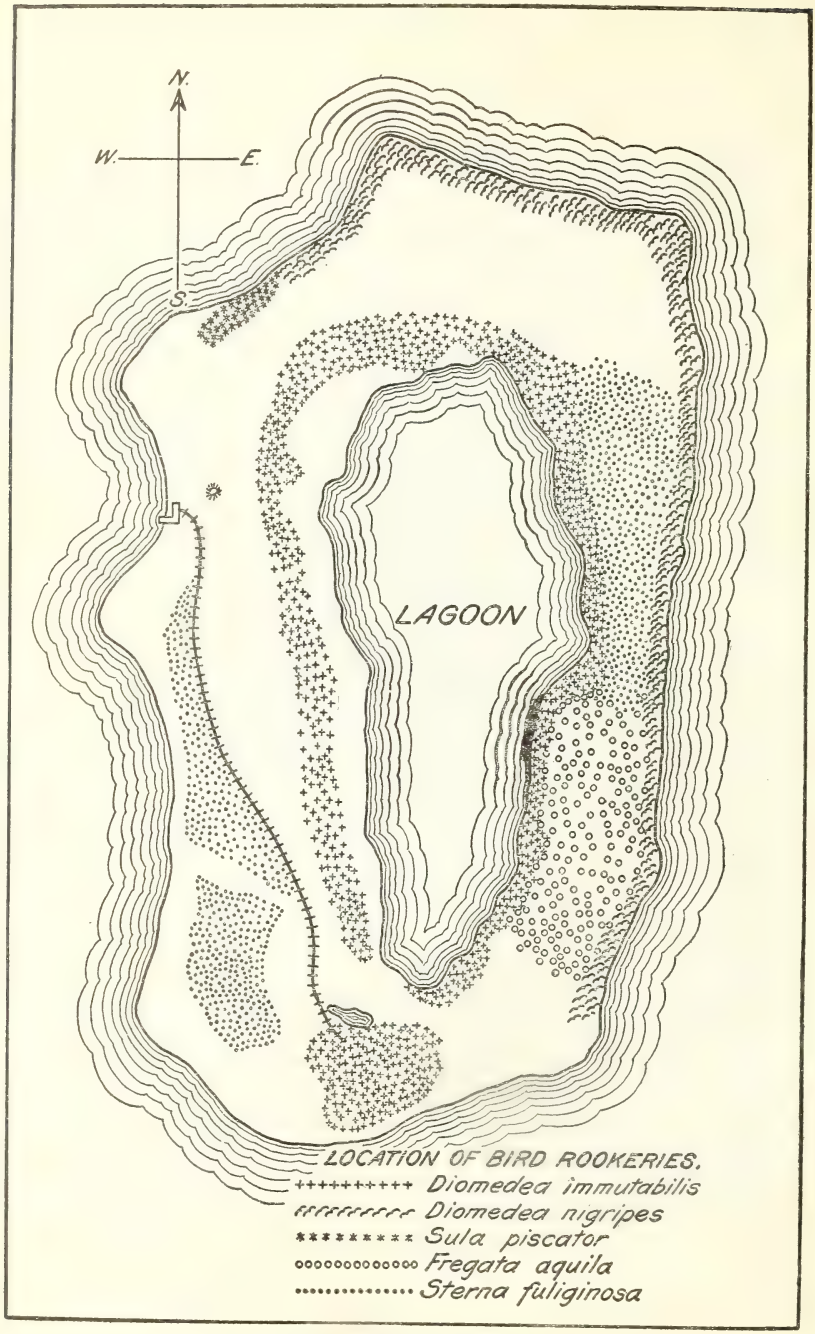


FIG. 1.—Map of Laysan Island.

square yard of ground. About 1 nest in 50 contained two eggs, one egg being the usual complement.

Sterna lunata Peale. Gray-backed Tern.

On the rocks at the south end of the island is a small colony of gray-backed terns. Its close proximity to the sooty tern rookery might mislead the casual observer as to the number of birds of this species. As soon as the birds are disturbed the sooty terns fly about with the graybacks, giving the impression that there are thousands of the latter. The unfortunate grayback makes a desirable skin for millinery purposes; hence his demise.

There are other small rookeries on the east side, and we estimated that about 50,000 of these birds were nesting on the island. We found fresh eggs and young birds in all stages of development.

Anous stolidus (Linn.). Noddy.

Noddies were nesting in small colonies on nearly all parts of the island. The northwest point seemed to be a favorite nesting place, and during the last week of May fresh eggs were found. The noddy is fairly abundant, numbering about 5,500.

Micranous hawaiiensis Rothschild. Hawaiian Tern. (Pl. III.)

This little understudy of the noddy was found in all stages, from a freshly laid egg to a fully fledged bird. It was not so abundant as the noddy, numbering about 3,000.

Gygis alba kittlitzi Hartert. White Tern or Love Bird.

During the first week of our stay in Laysan we saw but four white terns (Pl. IV, fig. 1). This little bird, never abundant on the island, was one of the first to disappear at the hands of the poachers.

About the time the sooty terns arrived in abundance we noticed a number of white terns. On the 15th of May we discovered several pairs nesting on the rocks at the south end and later found others on different parts of the island. At one time we were able to count 30 of these birds.

We collected six specimens, all of which, although nesting, were more or less pin-feathery and unfit for mounting. We estimated the number of this species to be 75.

DIOMEDIIDÆ.

Diomedea immutabilis Rothschild. Laysan Albatross. (Pl. V.)

Along the shores of the lagoon and on a small area at the south end of the island this most remarkable and interesting bird has taken its last stand. To-day there is about one-sixth of the original colony left. All along the car track and on the main rookery where the birds were formerly so abundant, only piles of bones remain. The

poachers killed these helpless creatures with clubs and threw the wings and feathers into the cars, heaping the bodies up along the sides of the track as they worked, and used the cars to carry the spoils to the sheds.

About all of the old main rookery, where the birds were reported so plentiful by Prof. Nutting in 1902, has been annihilated; only now and then a pair of birds with young may be seen. Along the shores of the lagoon they are still to be found in large numbers, and to one who has never seen such masses of birds it is a wonderful sight.

Notwithstanding the treatment these birds have received, they still seem fearless of man, with the exception, perhaps, of a few stray individuals nearer the buildings which will not allow one to approach them.

They amuse themselves with a strange proceeding, which at times seems to be done more from a sense of duty than for pleasure. The performance is varied, but usually begins as follows: One bird approaches another with an indescribable squeaking sound, bowing all the time. If the other bird feels like performing, which is usually the case, he bows in return. They cross bills very rapidly several times. Then one bird turns its head and lifts one wing in such a manner that the primaries point directly out at the side. In the meantime the other bird keeps up a loud noise that sounds somewhat like the neighing of a horse. The bird taking the lead then walks around his partner, stepping high like a negro cakewalker. This part of the procedure is usually closed by one or both birds pointing their beaks straight up in the air, rising on their toes, puffing out their breasts, and uttering a long-drawn groan. The same thing is repeated many times with slight variations.

There were comparatively few young albatrosses. When the parent birds were feeding at sea, the rookery would seem almost deserted. We found a number of young birds dead, but the mortality from natural causes is not large, considering the number of this species. Something must have disturbed the birds earlier in the nesting season; possibly their eggs may have been taken.

An accompanying map (p. 14), on which I have indicated the larger rookeries, will show about the area occupied by this species. At the present time there are approximately 180,000 Laysan albatrosses.

For the benefit of those who have estimated the number of albatrosses as high as 10,000,000, I would like to call attention to the map made by the officers of the *Albatross* in 1902. According to this map Laysan has an area of about 5,420,800 square yards. Taking out the area of the lagoon, which is 471,500 square yards, we have 4,949,300 square yards. Place 10,000,000 birds the size of an albatross upon 4,949,300 square yards of ground; how much room would

NESTING COLONY OF HAWAIIAN TERNS, LAYSAN ISLAND.

FIG. 1.—WHITE TERNS OR LOVE BIRDS, LAYSAN ISLAND.

FIG. 2.—COLONY OF WEDGE-TAILED SHEARWATERS, LAYSAN ISLAND.

LAYSAN ALBATROSS ROOKERY.

FIG. 1.—CHRISTMAS ISLAND SHEARWATER ON NEST, LAYSAN ISLAND.

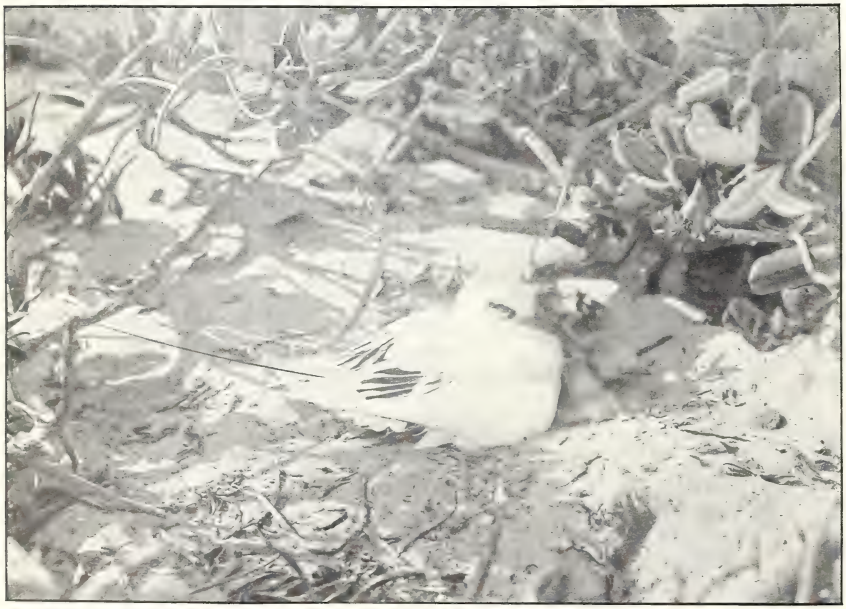


FIG. 2.—RED-TAILED TROPIC BIRD WITH YOUNG, LAYSAN ISLAND.

there remain for the rest of the bird population, to say nothing of the bushes and grass?

Diomedea nigripes Audubon. Black-footed Albatross.

Along the beaches of the north, east, and south sides of the island the black-footed albatross has taken almost complete possession. An occasional pair may be found nesting with the white species, but as a rule they are found by themselves.

The black-footed albatross is somewhat larger than the white species, and when seen on the wing it is instantly recognized as being far superior as an aviator. They followed our ship all the way from San Francisco to the Hawaiian Islands.

These birds have a performance similar to that of the former species, but much more elaborate, and they go through the figures slowly and gracefully. Instead of lifting one wing they raise both. The notes uttered during the performance are much softer, and it ends with a sound like the stroke of a bell under water or deep within the bird's stomach.

They are very neighborly with the other species. We often saw them visiting, and on one or two occasions they were trying to perform with them, but the rapid pace set by the white bird was rather too much for his more deliberate cousin and the affair ended disastrously.

The young of this species were rather abundant. During the first week of June many of them were fully fledged. The total number of black-footed albatrosses is about 85,000.

PROCELLARIDÆ.

Puffinus cuneatus Salvin. Wedge-tailed Shearwater.

The wedge-tailed shearwater (Pl. IV, fig. 2) is found on nearly every part of Laysan, with the exception of the beaches and the hard shores of the central lagoon. It does not fly about much during the day, but sits in the mouth of its burrow and dozes in the sun. At times a dozen or more of these birds congregate, apparently for the purpose of quarreling. Their cat-like squalls will soon make the listener wish to move out of hearing.

The young were nearly fledged. Apparently these birds were not killed to any extent by the poachers and they number about 100,000.

Puffinus nativitatis Streets. Christmas Island Shearwater.

The Christmas Island shearwater (Pl. VI, fig. 1) is a common bird on Laysan. We found it nesting under bushes and in shallow burrows. Its eggs were fresh during the first two weeks of May. Its retiring habits and unattractive plumage have protected it from the ravages of the poachers and it numbers about 75,000.

Æstrelata hypoleuca Salvin. White-breasted Petrel, or Bonin Island Petrel.

Owing to its nocturnal habits the white-breasted petrel is not so conspicuous as some of the other species of its family, but it was abundant in the evening. It is a fearless, dove-like creature, quite amenable to petting and stroking.

The young of this species were nearly fledged. They were to be seen in the mouths of the deep burrows which completely honeycomb the higher ground of the island. This species bids fair to hold its own for some time to come, numbering 160,000.

Bulweria bulweri (J. & S.). Bulwer's Petrel.

In Dr. W. K. Fisher's report of the Birds of Laysan Island, 1902, he states that he did not detect any Bulwer's petrels on Laysan. We were, therefore, somewhat surprised to find this species rather abundant, and at the same time of year that Dr. Fisher was there.

In the cracks and crannies of the rocks on the south end of the island one was sure of finding these birds, and in almost every case a pair of birds would be in the same opening. We found them also on other parts of the island, wherever there were pieces of phosphate rock or coral under which to crawl.

While we were after some specimens of coral rock, we were much surprised to find one of these quiet little birds sitting in the débris that had fallen from the under side as we applied the sledge hammer from above. The pieces had dropped in such a manner that, notwithstanding the falling of a piece weighing 75 pounds or more, the bird was unharmed and apparently not alarmed. Under the bird we found a fresh egg. This incident occurred on the 2d day of June, and although we had previously seen many of these birds, we had not found any eggs. Upon further investigation we found that the birds on the south end of the island had eggs, all of which were fresh. In some nests we found both birds sitting side by side. We estimated the number of this species to be 1,000.

Oceanodroma tristrami Salvin. Sooty Petrel.

The sooty petrel is not a common bird on Laysan. Near the south end of the lagoon a number of young birds were found, all dead or in a dying condition. They were fully fledged, retaining only traces of down. A diligent search procured but two adult birds. These birds were so much smaller than the measurements given by Mr. Ridgway for this species that there was at first some question as to their identity.

The following table gives Mr. Ridgway's measurements, also those of the specimens referred to above:

O. tristrami.

MEASUREMENTS BY MR. RIDGWAY.

Sex.	Date.	Length.	Wing.	Tail.	Fork of tail.	Culmen.	Depth bill front of nostril.	Tarsus.	Mid. tel.
.....	.....	Skin; about 11 inches.	7.50	4.45	1.60	0.70	0.25	1.10	1.10

SKINS COLLECTED ON LAYSAN BY OUR PARTY.

♀	Apr. 28	10.00	7.00	4.3	1.50	0.8	0.22	1.02	1.04
♂	May 22	9.8	6.54	4.1	1.20	.8	.20	1.04	1.06
♂	May 29	9.00	5.8	4.16	1.25	.76	.20	.94	1.16

PHAËTHONTIDÆ.

Phaëthon rubricaudus Boddaert. Red-tailed Tropic Bird.

During the first three weeks of our stay on the island we saw very few red-tailed tropic birds (Pl. VI, fig. 2). They were wild and very hard to catch. Later, however, we saw plenty of them, and as they were nesting, we experienced no trouble in catching them in our hands.

This species has by far the most beautiful plumage of any of the birds found here. Its rose-tinted satin body, with bright coral red beak, and its elongated central tail feathers make it a striking bird indeed.

The poachers have killed many of these birds, but they still seem fairly abundant, numbering about 300.

SULIDÆ.

Sula cyanops (Sundevall). Blue-faced Booby.

A small colony of blue-faced boobies (Pl. VII, fig. 1), was nesting on the sandy beach of the east coast. By actual count, 45 birds were there during the first week in May. Large downy young were in the nests, usually one but in some cases two. A few eggs were found, but all were well incubated.

On the 5th day of June we were somewhat surprised to find about twenty pairs of these birds nesting on the interior slope of the east side of the island in close proximity to the man-o'-war bird rookery. Why they should choose such an environment is hard to understand. Nearly all the nests contained two fresh eggs.

Not far from this spot we saw a man-o'-war bird pursuing a booby which had just returned from fishing, with a crop full of fish. At first it seemed as though the booby would outfly its pursuer, but its load was too heavy. The man-o'-war bird overtook the booby, seized it by the tail, raised itself in the air, and turned the booby completely over. Being thus rudely overturned the booby lost

control and quickly disgorged the contents of its crop, and the man-o'-war bird actually caught the fish as it came from the booby's mouth.

Sula piscator (Linn.). Red-footed Booby.

The red-footed booby (Pl. VII, fig. 2), like its relative, is not very abundant. They are confined to a small area on the north part of the island, nesting in the tops of low bushes. Their numbers increased about the same time we noted the increase of the former species. There were about 125 birds in all.

FREGATIDÆ.

Fregata aquila (Linn.). Man-o'-war Bird.

On the inner eastern slope of the island the man-o'-war birds (Pl. VIII) may be found. They nest in colonies in the tops of low bushes which, if placed near together, would cover about 6 acres. As it is, however, they appear to cover many times that amount of space.

Here sitting quietly on each nest is the owner thereof, holding down his claim. When one bird leaves the nest its mate immediately takes its place, for if a nest is left unguarded the birds that seem to be off duty swoop down, apparently passing nearly over it, when with a quick movement of the beak they pick up a stick and carry it away. Thus stick by stick the nest is completely removed. If there happens to be a young bird or an egg in the nest, it is destroyed and eaten by the winged cannibals.

One forgets the shortcomings of these birds when he sees them sailing on motionless wing far above him. It would seem that they make use of the hot air currents arising from the island and thus sail about with very little effort.

It seems strange that man-o'-war birds should have increased in numbers, when we think of their wholesale slaughter of each other's offspring, but according to previous reports they were less abundant on Laysan formerly than to-day, numbering 12,500 at the present time.

ANATIDÆ.

Anas laysanensis Rothschild. Laysan Teal.

No signs of the Laysan teal (Pl. IX, fig. 1) were seen for the first few days of our stay, and then we found feathers and other parts of those which the marauders had dressed for food. Later, however, we saw them in small flocks, six being the most seen at one time. Some teals seemed to be nesting in the grass near the small fresh-water pond on the south end of the island, but we were unable to find any nests.

The man-o'-war birds persistently pursued them, but they did not to my knowledge kill or harm any of them. They may, however, kill young teals.

FIG. 1.—BLUE-FACED BOOBY, LAYSAN ISLAND.

FIG. 2.—RED-FOOTED BOOBY, LAYSAN ISLAND.

MAN-O'-WAR BIRDS ON NESTS, LAYSAN ISLAND.

FIG. 1.—LAYSAN TEAL.

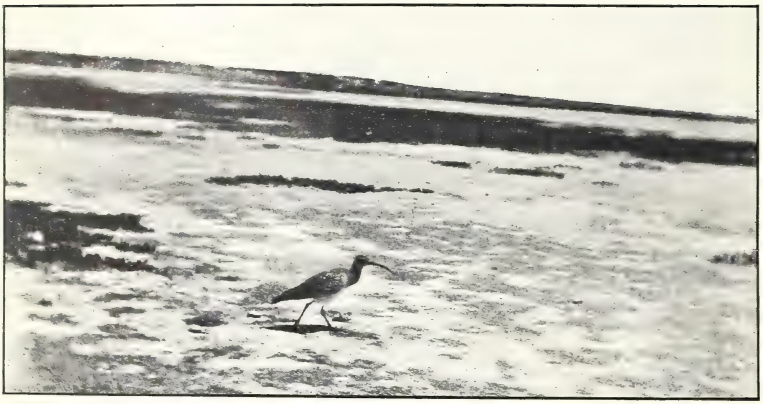


FIG. 2.—BRISTLE-THIGHED CURLEW, LAYSAN ISLAND.

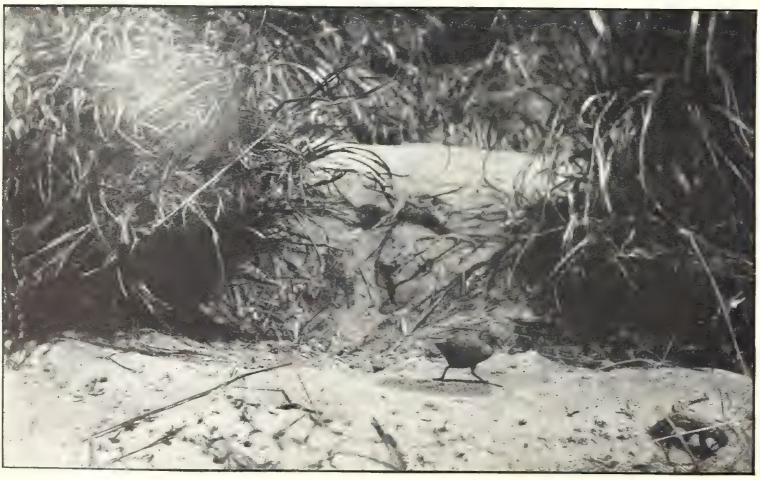


FIG. 3.—LAYSAN RAIL.

Presumably the plumage hunters killed these birds for food, and thus nearly exterminated them. It would seem that without further molestation they might increase in numbers.

RALLIDÆ.

Porzanula palmeri Frowhawk. Laysan Rail.

The Laysan rail (Pl. IX, fig. 3) is one of the most interesting birds found on the island. Notwithstanding its inability to fly it has no trouble in evading its pursuers. It runs and dodges from one grass tussock to another, down a petrel hole and out again before one can locate it. One of the most laughable things imaginable is a man pursuing one of these bits of bird life, net in hand, continually dropping waist-deep down among the burrowing petrels. It was with much difficulty that we secured the specimens we needed for our collection. They were everywhere fairly abundant on all parts of the island excepting the beaches. They even visited our kitchen. Their favorite nesting place is among the thick mats of juncus along the margin of the lagoon. We found many nests but no eggs. On the 4th day of June we discovered two coal-black chicks with yellow beaks that gave vent to much noise. There are about 2,000 rails on the island.

SCOLOPACIDÆ.

Heteractitis incanus (Gmelin). Wandering Tatler.

Very few of these birds were seen on Laysan during our stay. Now and then one or two would be seen on the reef or among the large rocks on the beach, but they were very wild. One specimen only was secured.

Numenius tahitiensis (Gmelin). Bristle-thighed Curlew.

Just before sunset and early in the morning the bristle-thighed curlews (Pl. IX, fig. 2) would come up around our camp uttering their peculiar complaining notes. They roosted on the roofs of the old buildings at night, sometimes as many as 20 birds in one flock. We saw them feeding on different parts of the island but usually about the lagoon or along the beaches. They number about 250.

CHARADRIIDÆ.

Charadrius dominicus fulvus (Gmelin). Pacific Golden Plover.

The golden plover is only a migrant on Laysan. About 2,000 were present at the time of our visit.

APHRIZIDÆ.

Arenaria interpres (Linn.). Turnstone.

In the shallow water of the lagoon and about the fresh water pond, large flocks of plover and turnstones were to be seen. Here they spent most of their time feeding on the small flies with which the shore and water are black.

The specimens we prepared for our collection were exceedingly fat. We experienced some difficulty in securing good ones, as the birds were too wild to catch in a hand net and were easily ruined with a shotgun. The turnstones number about 2,500.

DREPANIDIDÆ.

Himatione fraithii Rothschild. Laysan Honey Eater.

The honey eater is not common on Laysan. There were four birds of this species that roosted on an old rope which hung across the corner in one of the sheds. Here each night we would see them huddled closely together. An occasional bird would flit into our workroom in quest of millers. They were to be seen about the island in the tall tussocks of grass, where we found a few nests, all of which contained young birds or well-incubated eggs. Among the old specimens left by the feather hunters we found several skins of the honey eater. There are possibly 300 living birds of this species.

Telespiza cantans Wilson. Laysan Finch.

One of the last birds to disappear from the island will be the Laysan finch. With its omnivorous habits and its saucy, fearless manner it easily adapts itself to conditions as it finds them. It is a fine songster and makes a good cage bird. Laysan Island is an ideal place for this bird, but should anyone be rash enough to introduce it to a civilized community it would be a pest that would rival the English sparrow.

They were everywhere abundant about the island, particularly near the tern rookeries. When we passed through the rookeries they would follow, to steal the eggs left exposed by the terns we had frightened away. They also eat other birds' eggs, not excepting their own species.

Our cook experienced much difficulty in keeping them from the kitchen. Each day brought more birds. At last he was obliged to put up a net at the door to keep them out. They also visited our storeroom, where they picked holes in our rice bag, making way with quite a quantity. At meal time they were about our feet picking at the crumbs on the floor. It was not an uncommon thing to see them on the table. They were nesting during the month of May, and we found many nests with fresh eggs. We estimated the total number of finches to be about 2,700.

SYLVIIDÆ.

Acrocephalus familiaris (Rothschild). Miller Bird.

With the exception of the Laysan teal, the miller bird is the least abundant of the indigenous birds. We saw a few of them around the old buildings and others about the island, but principally along the

west shore of the lagoon, in the tall grass, where a few nests containing eggs and young birds were found.

A pair made a nest not far from our sleeping quarters. The birds seemed not to mind our presence, working away at the nest when we were within 2 feet of it. After it was completed, the female bird died while laying an egg. We saved the skin of the bird, also the egg, which was removed intact. In a few days the male bird returned with a new mate, and, much to our surprise, the birds took down the nest, building a new one a few feet away.

It seems strange that this bird should not be more common, as it was formerly reported to be most abundant of the land birds. Presumably the poachers caught the miller bird, but we have no proof of it, as no skins or other parts were found. Its numbers are kept in check by the finches—at least we saw the latter eating the eggs of this species. Undoubtedly, however, this has been their practice for many years, and, unless the finches are more abundant than formerly, it ought not to make any appreciable difference in the numbers of the miller bird.

ISLAND BIRD CENSUS.

An estimate of the number of each species of bird found on the island was made. The method of estimating the number in the several rookeries was as follows: After carefully measuring a rookery, a square yard was selected that seemed to contain a fair average of nests. Counting two birds to a nest we determined the number in a rookery. In some cases this method could not be used, as some species do not assemble in large numbers but nest in small colonies among the other species. The map (p. 14) accompanying this report is not a criterion as to the number of birds in the various rookeries, but simply shows the location and approximately the area covered by the species indicated thereon. To avoid confusion I have indicated thereon only the birds that have sharply defined rookeries, the others being more or less united.

The following table shows at a glance the estimated numbers of most of the island birds:

Sterna fuliginosa	333,900	*Sula cyanops*	65
Sterna lunata	50,000	*Sula piscator*	125
Anous stolidus	5,500	*Fregata aquila*	12,500
Micranous hawaiiensis	3,000	*Anas laysanensis*	6
Gygis alba kittlitzi	75	*Porzanula palmeri*	2,000
Diomedea immutabilis	180,000	*Numenius tahitiensis*	250
Diomedea nigripes	85,000	*Charadrius dominicus fulvus*	2,000
Puffinus cuneatus	100,000	*Arenaria interpres*	2,500
Puffinus nativitatis	75,000	*Himatione fraithii*	300
Æstrelata hypoleuca	160,000	*Telespiza cantans*	2,700
Bulweria bulweri	1,000		
Oceanodroma tristrami	3		1,016,224
Phaëthon rubricaudus	300		

PART II.

REPORT ON CONDITIONS ON LAYSAN, WITH RECOMMENDATIONS FOR PROTECTING THE HAWAIIAN ISLANDS RESERVATION.

By Wm. Alanson Bryan,
Professor of Zoology in the College of Hawaii.

INTRODUCTION.

On the occasion of my recent visit to Laysan Island during the week from April 24 to 30, 1911, which was made on board the U. S. revenue cutter *Thetis*, in company with a party from the State University of Iowa who were making the journey to the island to secure material and background studies for a large group to be assembled at that institution, I was able to study conditions as I found them in this wonderful bird colony and compare them with conditions existing there at the time of my former visit in April, 1903.

The slaughter of tens of thousands of birds by the party of feather and wing hunters and the depredations now being wrought by the rabbits and guinea pigs that have been introduced on the island make it important, if this colony is to be saved from extermination, that every effort to this end be made, both by the Federal Government and by the Territory of Hawaii. It will be necessary (1) to have the islands in the Leeward chain of the Hawaiian group properly patrolled and protected; (2) to take steps to exterminate or reduce the rabbits on Laysan Island; (3) to distribute the peculiar land birds on Laysan to other islands of the chain in order to prevent their early extermination; (4) to introduce the important economic species on the inhabited islands of the group; (5) to plant on Laysan and the other islands certain trees and shrubs that will flourish on them; (6) to develop this valuable possession of the Territory of Hawaii as the great natural parks are developed elsewhere—as a natural breeding preserve for wild birds. Since the birds are all perfectly fearless, the reservation may be visited at any season under proper regulations, thus affording to the Hawaiian Islands a unique opportunity to preserve this great colony in a flourishing condition and at the same time utilize the chain of otherwise unimportant and unproductive islands, over a thousand miles in length, as a cruising and camping park and fishing ground, the like of which is found nowhere else in the world.

Several months ago it became my duty as the representative of the National Association of Audubon Societies in Hawaii to notify that society and the Biological Survey that the island of Laysan of the Leeward chain of this group had been visited by a company of feather hunters. They were under the employ of Mr. Max Schlemmer, now of Honolulu, but who was for many years a resident on Laysan as manager for a large guano and fertilizer concern with headquarters in Honolulu.

After spending several months on the island engaged in the wholesale slaughter of the bird life there, the poachers were taken off by the U. S. revenue cutter *Thetis* under command of Capt. Jacobs, who was sent there by the Federal Government for that purpose. With the 23 poachers who were brought to Honolulu for trial the *Thetis* brought two or three carloads of the feathers, wings, and birdskins that had been made ready for shipment to Japan. Had the plan of the promoters been carried out, they would doubtless have been sent from Japan to the fashion centers of Europe and America for millinery purposes.

COMPARISON OF CONDITIONS IN 1903 AND 1911.

By my experience on Marcus Island and Midway Island a few years ago, where I had the sad privilege at the first-named island of finding a colony of poachers actually engaged in killing birds by the thousands for the millinery market, and at the latter of finding the hundreds of heaps of dead birds' bodies left by a party that had finished securing its ship load of wings and feathers, I was in a measure able to anticipate the damage that had been done by these ruthless spoilers at Laysan.

My surprise was great, however, to find that the few rabbits introduced by Mr. Schlemmer shortly after my former visit had literally taken possession of the island. In 1903 Mr. Schlemmer, then operating a lease and engaged in the guano business, made a number of trips from Honolulu. On a number of these voyages he took several small shipments of rabbits of different breeds as well as a number of Japanese guinea pigs. All of these animals were liberated on Laysan and they have since multiplied until they are found in great numbers at this time.

The slaughter wrought by the plume hunters is everywhere apparent. One of the work buildings formerly used by the guano company and later as a storehouse by the poachers is still standing. With a side torn out and left open to the weather by the men of the *Thetis*, it is still filled with thousands of pairs of albatross wings. Though weatherbeaten and useless, they show how they were cut from the birds whose half-bleached skeletons lie in thousands of heaps scattered all over the island.

This wholesale killing has had an appalling effect on the colony. No one can estimate the thousands, perhaps hundreds of thousands, of birds that have been willfully sacrificed on Laysan to the whim of fashion and the lust for gain. It is conservative to say that fully one-half the number of birds of both species of albatross that were so abundant everywhere in 1903 have been killed. The colonies that remain are in a sadly decimated condition. Often a colony of a dozen or more birds will not have a single young. Over a large part of the island, in some sections a hundred acres in a place, that 10 years ago was thickly inhabited by albatrosses, not a single bird remains, while heaps of the slain lie as mute testimony of the awful slaughter of these beautiful, harmless, and without doubt beneficial inhabitants of the high seas.

While the main activity of the plume hunters was directed against the albatrosses, they were by no means averse to killing anything in the bird line that came in their way. As a consequence large numbers of all the different species of birds that occur on the island were killed. Among the species slaughtered may be mentioned black-footed albatross, Laysan albatross, sooty tern, gray-backed tern, noddy tern, Hawaiian tern, white tern, Bonin Island petrel, wedge-tailed shearwater, Christmas Island shearwater, red-tailed tropic bird, blue-faced booby, red-footed booby, man-o'-war bird, bristle-thighed curlew, and without doubt many of the few species of the smaller birds peculiar to Laysan as well as those that visit it as migrants.

Fortunately, serious as were the depredations of the poachers, their operations were interrupted before any of the species had been completely exterminated. So far as the birds that secure their food from the sea are concerned, it is reasonable to suppose they will increase in number, and that nature will in time restore the island to its former populous condition if no further slaughter is permitted. Owing to the indiscriminate method of the killing, usually only one or the other of mated pairs was sacrified. The unmated birds that survive are slow in selecting another mate. As but a single egg is laid by the majority of these birds, it will possibly take 10 years for the sea birds of the colony to regain their former numerical strength.

With the land birds an entirely different condition exists. All the small species peculiar to the island, except possibly the Laysan teal, depend entirely upon the vegetation on the island for their food supply. The uninterrupted and astonishing increase in the numbers of rabbits and guinea pigs can have but one result if allowed to continue unchecked. They will surely eat or kill off all of the grass and shrubs. Doubtless the insects that feed on the plants and in turn are fed upon by the birds will be so reduced as to bring about starvation among the small birds.

The struggle for existence on Laysan is most keen at all times. The inevitable operation of the law of nature that balances the food supply with the number to be fed is as effective on this sand island as it is everywhere else in the world. As a matter of fact, a marked reduction in the number of pairs of all the land birds can be noticed as compared with the number of the same species on the island eight years ago. The Laysan canary, Miller bird, Laysan honey eater, and the Laysan rail, without doubt, are doomed to extermination on the isolated island on which they have maintained themselves long enough to develop into distinct species, unless something is done to preserve for them the source of their food supply.

Rare as the Laysan teal has always been, it is gratifying to find that it has not been wiped out of existence. Eight years ago there were several small flocks of this interesting bird, which is without doubt the rarest wild duck in the world. This year only seven adult birds were seen during an entire day especially devoted to watching for it on the small fresh-water lake and the main lagoon—the natural rallying place for the species. Ducks were seen on five of the seven days spent on shore, but there were by no means as many of them as there were on the occasion of my former visit. One pair seen had a flock of five young following them. Thus it will be seen that while this rare species is not extinct, as was greatly feared, it is so rare that there are probably not more than a half dozen adult pairs on the island at this time.

Even after the wholesale slaughter of the birds and the result it had on their nesting and mating habits, the birds remain as fearless as ever. There is not a species on Laysan that can not be caught in the hands with a little care and patience. One pair of ducks, for example, came up within 6 feet of the writer, a lack of fear which would make the species an easy one to exterminate should poachers at any time make another raid on the island inhabitants.

Rabbits now literally swarm over the island by thousands. The amount of damage done by them can better be imagined than told. They are exterminating first one species of plant then another. Several species that were common everywhere eight years ago have entirely gone, others are already doomed. Unless some drastic measures are resorted to within a very short time not a bush or spear of grass will be alive.

There is no indication that the islands of Laysan and Lysianski have been visited by hunting vessels since the last visit of the *Thetis*. It is to be hoped that for the time being at least the traffic in birds' wings and feathers has been broken up in these waters. However, there is no assurance that it will not be renewed without notice, hence the necessity for continuing the service of the *Thetis* or a similar vessel, and the necessity of making frequent visits at irregular intervals to all of the islands of the reservation.

RECOMMENDATIONS FOR FUTURE PROTECTION OF THE RESERVATION.

As to the future care of this wonderful colony, I would suggest that the most effective way to conserve the bird life is to appoint a warden for the reservation who should have general supervision of these low-lying islands and their bird inhabitants. A resident warden should then be provided who should be supplied with a small auxiliary power schooner, or a large power sampan, that would enable him to make frequent and unannounced visits at irregular intervals to all of the islands along the chain. The installation of a wireless telegraph station at Midway, where the power and facilities are already available, would add greatly to the convenience and safety of commerce and trans-Pacific travel and would put the islands of the chain in direct touch with Honolulu and the outside world.

If a vessel such as has been suggested should be stationed at Laysan or Midway Island it would be an important step toward the proper supervision of all the outlying islands, whether included in the reservation or not. Naturally the people and the authorities of the Territory of Hawaii feel a keen interest in the welfare of this reservation. A feeling is growing that the day is not far distant when this Territory will look upon the Leeward chain of islands as forming a great natural park as interesting and wonderful in its way and as instructive to visit as are any of the other famous national parks.

The visiting of these islands and reefs by interested persons, should they be opened to the public under proper regulations and supervision, will result in no harm to the breeding colony, as the long residence of the guano company on the island of Laysan has proven. As years go by and the birds become more rare elsewhere, the great reservation thus conserved in the mid-Pacific will be an object of world interest and concern. The birds themselves are a valuable possession to Hawaii and the nation, while as an attraction to visitors as well as to the residents of these islands they represent, as yet, an asset that is scarcely appreciated.

It is urged that the Federal Government and the Territorial government should at once become actively interested in these islands and that measures should be taken to safeguard the birds against the possibility of further despoliation by plume hunters. It is also urged that steps should be taken to introduce the rare land birds of Laysan on other of the low islands of the chain where conditions are favorable in order to prevent the extermination of these interesting and valuable birds in the manner I have suggested.

At least three of the land forms of Laysan are of unquestioned economic importance and of great value to the Territory of Hawaii as the natural enemies of certain noxious and injurious insects. The difficult problem of their transportation and introduction into the

inhabited islands should be taken up vigorously and without delay by the Territorial government. One of the main objects of the writer's recent trip to Laysan was in the interest of the Territory and made for the purpose of studying the habits of these birds on the ground with the foregoing practical object in view. The visit just made and the experiments carried on while en route and on the island resulted in working out simple and practical methods of transportation which, it is believed, if followed up, will make it possible to capture and transport living specimens of these delicate insect-eating species for long journeys at sea without serious loss.

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